DETAILS OF THE WEATHER IN THE UNITED STATES.

GENERAL CONDITIONS.

By A. J. HENRY.

As a whole, the month was characterized by cyclones that lacked in intensity, by anticyclonic movement with a larger than usual southerly component of motion, and by dry weather in the great majority of districts.

CYCLONES AND ANTICYCLONES.

By W. P. DAY.

No really important storms were charted within the area of the United States proper, although one or two good blows occurred on the North Pacific coast, the Lake region, and the North Atlantic coast, and disturbed conditions prevailed over the Gulf of Mexico during a large part of the month. The influence of the hurricane which traversed the northern portion of the Province of Yucatan in Mexico was not felt north of the Tropics.

High-pressure areas were about normal in number, movement, and with respect to place of origin.

Tables showing the number of cyclones and anticyclones by types are given below. Two storms of tropical origin are not included, though shown in part on Chart II.

Cyclones.	Alberta.	North Pacific.	South Pacific.	Northern Rocky Mountain.	Colorado.	Texas.	East Gulf	South Atlantic.	Central.	Total.
October, 1922....	4.0	2.0	.....	2.0	1.0	1.0	2.0	1.0	1.0	14.0
Average number, 1892-1912, inclusive.....	4.2	1.3	0.7	0.5	1.7	0.7	0.4	0.5	0.3	10.3

Anticyclones.	North Pacific.	South Pacific.	Alberta.	Plateau and Rocky Mountain. region.	Hudson Bay.	Total.
October, 1922.....	4.0	.....	4.0	.....	1.0	9.0
Average number, 1892-1912, inclusive	2.8	0.9	3.0	1.2	0.6	8.5

FREE-AIR CONDITIONS.

By L. T. SAMUELS.

Free-air temperatures during the month were mostly above their normal values (Table 1). At Broken Arrow, Due West, and Ellendale these positive departures increased generally with altitude, while at Drexel they were only slightly smaller in the upper levels. At Groesbeck no appreciable change in the amount of the departures was found, while at Royal Center they were negative throughout, although considerably smaller in the higher levels. Comparison of surface departures with those given in Climatological Chart III shows good agreement with the exception of Royal Center. This apparent discrepancy is due partly to the short period available for which normals are computed and which, in this case, is obviously influenced to a greater degree than it should be by the unusually high mean for 1920, and in part to the smaller southerly component in the resultant winds as compared with the average for the month. (Table 2). It is of interest to note the direct connection between the wind direction and temperatures in the fact that on days when either record maximum or minimum temperatures for various levels were recorded the wind direction at the time had a southerly or northerly component, respectively.

Relative humidity departures were in general negative for all stations and levels, while those for vapor pressure conformed as a whole with the temperature departures.

In Table 2 are shown the resultant wind directions and velocities for the month and their averages. At the four stations having the largest positive temperature departtures it will be noted that the resultant winds in most cases have either a greater southerly or a smaller northerly component than the average. The resultant winds at Groesbeck show a decidedly greater easterly component than normal.

At this time of the year winds begin to manifest characteristics of the winter season, particularly as regards increased velocities and less frequent easterly components at high altitudes. Pilot-balloon observations at numerous stations in the eastern and central sections of the country from the 18th to the 21st showed winds of hurricane velocity in the upper levels. Of particular interest during this period is the single-theodolite pilot-balloon observation made at Fort Bragg, N. C., on the morning of the 20th, when a velocity of 77 m. p. s. (172 m. p. h.) from the WNW. was observed at an altitude of 9,100 meters. The question of the reliability of the assumed ascensional rate upon which single-theodolite observations are necessarily based becomes at once of great consequence, and comparison with surrounding stations is of vital importance before accepting as correct such tremendous velocities. Simultaneous observations at the following stations showed velocities as follows:

Station.	Velocity.	Direction.	Altitude.
	m. p. s.		*m.*
Due West, S. C.	42	W.	8,400
Fort Benning, Ga.	35	W.	10,000
Mitchel Field, N. Y.	42	WNW.	4,000

Observations made just prior to, and shortly after, those given above, when extremely high upper velocities were general over this region, strongly substantiate the great velocity found at Fort Bragg on the 20th. This region was at the time under the influence of a widespread anticyclone, central to the northward, causing easterly winds in the lower levels. These winds became westerly above 3,000 meters and then increased greatly in velocity. The cause of these extreme velocities is plainly revealed on the weather maps for this period and is to be found in the sharp surface-temperature gradient extending from south to north. On the morning of the 19th it will be noted that this ranged from 28.9° C. in southern Florida to 1.1° C. in northern Mississippi. Such a temperature gradient obviously causes a steep south-to-north pressure gradient in the upper air on account of the difference in the resulting air densities and, when sufficiently steep, causes tremendous velocities such as were recorded. Reference is made to the pilot-balloon observation made at Lansing, Mich., on December 17, 1919, when a wind of 83 m. p. s. from the NW. was recorded at 7,200 meters elevation.[1]

[1] W. R. Gregg, MO. WEATHER REV., December, 1919, 47: 853-854.

Easterly winds to at least 4 and 5 kilometers observed generally over the central and eastern portions of the country during the first four days of the month seem significant in view of the fact that a large anticyclone remained practically stationary over the eastern half of the country during this period. Upper easterly winds were reported from several stations in the Gulf States from the 25th to the 30th, some of these extending above 10,000 meters. During this period the pressure distribution remained practically unchanged in the eastern half of the country.

At Madison on the 9th and 10th easterly winds were observed to 8,000 and 10,000 meters, respectively. These winds appear significant in view of the fact that a cyclone central on the morning of the 9th over Greenville, S. C., moved north-northwestward, increasing considerably in intensity by the morning of the 10th, and easterly winds at Madison to 10,000 meters on this date are evidence of the great height to which the effects of this depression reached.

On the morning of the 18th pilot-balloon observations at Washington and Bolling Field, D. C., showed a similarity, too striking to be caused by chance, of rather unusual wind conditions. It is evident from these observations that at least five successive air strata existed superimposed and having alternately higher and lower velocities, although with no appreciable change in direction. These conditions were apparent, though to a smaller degree, at both Aberdeen, Md., and Dahlgren, Va. The morning weather map for this date shows this region to have been on the dividing line between a strong anticyclone central over Oklahoma and an extensive cyclone to the northeast, central over New Brunswick. It is believed the alternating influence of these pressure systems produced the variation in velocities in this region.

The pilot balloon at Groesbeck on the morning of the 28th was followed with a single theodolite to an altitude of 23,000 meters. At the close of the observation another was immediately started, using two theodolites, during which the balloon was followed to 9,000 meters. To this height the agreement between the two was very close. Above this the observation must be accepted with reservation, but, with an ever-increasing number of observations, indications point strongly to a reliable assumed ascensional rate even in these higher layers, although nothing of a definite nature can be obtained until double-theodolite observations to these heights have been made. A general southwesterly direction was found throughout. The greatest velocity was 23 m. p. s. occurring at the highest altitude.

During the night of October 31–November 1 a tornado occurred in the extreme southwestern part of Missouri. One of the fundamental conditions for the development of tornadoes is a vigorous convection between strong neighboring countercurrents. That this condition occurred is obvious from the observations at this time. On the morning of the 31st Broken Arrow reported north surface winds with lower clouds moving from the south. Pilot-balloon and kite observations were impracticable in this region during the time immediately preceding the tornado, owing to the low clouds and abundant precipitation. However, it is evident from cloud observations that southerly and northerly winds were overrunning and existed adjacent to one another, and with unusually high temperatures occurring at the surface in this region violent convection ultimately set in.

An interesting feature during the month was the large number of days at Ellendale on which the electric potential recorded during kite flights exceeded 10,000 volts. This station reported this occurrence on 22 days out of the month, while none of the other stations reported similar phenomona occurring on more than 3 days.

TABLE 1.—*Free-air temperatures, relative humidities, and vapor pressures during October, 1922.*

TEMPERATURE (°C.).

Altitude, m. s. l. (m.)	Broken Arrow, Okla. (233m.)		Drexel, Nebr. (396m.)		Due West, S. C. (217m.)		Ellendale, N. Dak. (444m.)		Groesbeck, Tex. (141m.)		Royal Center, Ind. (225m.)	
	Mean.	Departure from 5-year mean.	Mean.	Departure from 7-year mean.	Mean.	Departure from 2-year mean.	Mean.	Departure from 5-year mean.	Mean.	Departure from 5-year mean.	Mean.	Departure from 5-year mean.
Surface..	17.4	−0.2	14.3	+2.4	16.0	−0.4	8.0	+0.1	19.1	−0.2	12.5	−1.7
250.....	17.4	−0.1	.....	.....	15.8	−0.4	.....	.....	19.6	+0.5	12.5	−1.6
500.....	17.3	+1.1	14.1	+2.5	14.5	0.0	8.6	+0.6	18.7	+0.6	12.0	−0.7
750.....	16.1	+1.0	13.6	+2.9	13.6	+0.5	9.6	+1.8	17.7	+0.7	10.6	−0.8
1,000.....	14.3	+0.3	12.7	+2.7	12.7	+0.6	9.2	+2.0	16.5	+0.7	9.1	−1.1
1,250.....	12.9	−0.1	11.9	+2.5	11.6	+0.6	8.7	+2.3	15.2	+0.4	7.8	−1.2
1,500.....	11.7	−0.3	10.8	+2.3	10.8	+0.7	7.8	+2.2	13.8	+0.1	6.5	−1.3
2,000.....	9.7	−0.1	8.5	+2.4	9.0	+0.8	5.6	+2.3	11.2	−0.3	4.2	−1.3
2,500.....	7.5	+0.3	5.4	+2.0	7.1	+0.3	3.4	+2.7	8.9	−0.3	2.0	−1.1
3,000.....	4.9	+0.5	2.2	+1.6	4.9	+0.4	0.8	+2.9	6.9	−0.1	−0.7	−1.4
3,500.....	2.1	+0.5	−0.5	+1.6	2.7	+0.9	−1.7	+3.3	4.9	−0.1	−2.6	−0.7
4,000.....	−1.1	+0.2	−3.3	+1.5	1.1	+2.0	−3.7	+4.0	2.6	+0.1	−4.4	−0.4
4,500.....	−3.5	+0.6	−5.3	+1.6	−1.0	+2.0	−5.6	+4.9	−0.2	+0.3	−6.6	−0.4
5,000.....	−4.0	+2.6	−10.4	+1.6	−3.4	+2.0	−7.2	+6.0	.....	.....	.....	.....

RELATIVE HUMIDITY (%).

Surface..	55	−9	53	−7	69	+7	63	−3	64	−9	64	−3
250.....	54	−10	.....	.....	69	+7	.....	.....	60	−11	63	−4
500.....	49	−13	52	−7	65	+4	60	−4	55	−13	55	−9
750.....	49	−12	50	−7	63	+3	53	−6	55	−12	54	−8
1,000.....	50	−9	49	−6	60	+1	51	−6	55	−11	53	−7
1,250.....	49	−7	48	−4	57	00	48	−6	54	−10	52	−6
1,500.....	48	−6	48	−3	51	−3	46	−5	54	−8	52	−4
2,000.....	44	−3	49	−2	44	−5	43	−6	55	−1	46	−5
2,500.....	43	+2	51	0	38	−6	39	−9	54	+4	42	−5
3,000.....	40	+3	51	+1	32	−7	38	−9	47	+4	41	−6
3,500.....	36	+1	44	−4	27	−9	38	−10	46	+7	37	−3
4,000.....	36	+3	43	−3	18	−15	35	−10	41	+6	23	−15
4,500.....	31	+1	43	−1	15	−15	35	−10	40	+4	22	−16
5,000.....	11	−14	43	−1	14	−15	37	−7	.....	.....	.....	.....

VAPOR PRESSURE (*mb.*).

Surface..	10.84	−2.15	8.69	+0.19	12.71	+0.95	6.39	−0.53	14.03	−2.66	9.28	−1.65
250.....	10.79	−2.11	.....	.....	12.54	+0.91	.....	.....	13.36	−2.70	9.14	−1.65
500.....	10.11	−1.56	8.45	+0.22	11.39	+0.88	6.41	−0.41	11.90	−2.66	7.77	−1.68
750.....	9.41	−1.25	7.83	+0.79	10.52	+0.89	6.09	−0.33	11.18	−2.33	6.91	−1.52
1,000.....	8.56	−1.09	7.16	+0.65	9.56	+0.71	5.64	−0.26	10.35	−1.90	6.15	−1.50
1,250.....	7.72	−0.95	6.56	+0.65	8.32	+0.39	5.18	−0.15	9.38	−1.61	5.56	−1.30
1,500.....	6.93	−0.80	6.21	+0.78	6.98	+0.07	4.66	−0.12	8.60	−1.22	5.05	−1.02
2,000.....	5.41	−0.23	5.42	+0.87	5.31	−0.09	3.82	−0.09	7.49	+0.02	3.87	−0.82
2,500.....	4.52	+0.34	4.54	+0.89	3.78	−0.33	3.13	−0.13	6.45	+0.60	3.23	−0.44
3,000.....	3.56	+0.48	3.55	+0.69	2.97	−0.37	2.63	−0.03	5.21	+0.80	2.80	−0.18
3,500.....	2.84	+0.44	2.36	+0.16	2.14	−0.44	2.22	+0.04	4.55	+1.04	2.11	−0.32
4,000.....	2.37	+0.47	1.85	+0.12	1.32	−0.69	1.80	+0.14	3.63	+0.96	1.31	−0.48
4,500.....	1.87	+0.34	1.55	+0.16	1.01	−0.69	1.54	+0.28	3.53	+1.07	1.06	−0.53
5,000.....	0.96	−0.21	1.15	+0.16	0.76	−0.69	1.46	+0.49	.....	.....	.....	.....

TABLE 2.—*Free-air resultant winds (m. p. s.) during October, 1922.*

Altitude, m. s. l. (m.)	Broken Arrow, Okla. (233m.)				Drexel, Nebr. (396m.)				Due West, S. C. (217m.)				Ellendale, N. Dak. (444m.)				Groesbeck, Tex. (141m.)				Royal Center, Ind. (225m.)			
	Mean.		5-year mean.		Mean.		7-year mean.		Mean.		2-year mean.		Mean.		5-year mean.		Mean.		5-year mean.		Mean.		5-year mean.	
	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.
Surface	S. 8° W.	1.5	S. 5° W.	2.6	S. 24° W.	2.6	S. 30° W.	1.5	N. 44° E.	1.9	N. 39° E.	1.9	N. 53° W.	2.4	N. 58° W.	1.9	N. 52° E.	1.6	S. 44° E.	0.7	S. 48° W.	2.8	S. 41° W.	2.5
250	S. 7° W.	1.5	S. 4° W.	2.7	.....	.....	.....	.....	N. 41° E.	2.1	N. 39° E.	1.9	.....	.....	.....	.....	N. 62° E.	2.2	S. 30° E.	1.5	S. 50° W.	2.9	S. 41° W.	2.8
500	S. 13° W.	1.7	S. 12° W.	3.8	S. 28° W.	3.5	S. 33° W.	2.1	N. 51° E.	2.8	N. 43° E.	2.6	N. 54° W.	2.5	N. 61° W.	1.8	N. 70° E.	2.4	S. 13° E.	2.8	S. 61° W.	5.1	S. 51° W.	4.9
750	S. 23° W.	2.1	S. 17° W.	4.4	S. 39° W.	4.9	S. 46° W.	3.5	N. 67° E.	2.5	N. 53° E.	2.1	N. 73° W.	3.4	N. 67° W.	2.6	N. 81° E.	2.8	S. 5° E.	3.2	S. 77° W.	6.3	S. 59° W.	6.1
1,000	S. 33° W.	2.1	S. 24° W.	4.5	S. 51° W.	5.4	S. 58° W.	3.8	N. 78° E.	1.9	N. 54° E.	1.2	N. 78° W.	4.3	N. 69° W.	3.1	N. 80° E.	2.5	S. 3° W.	3.3	S. 79° W.	6.7	S. 65° W.	6.8
1,250	S. 31° W.	1.9	S. 35° W.	4.5	S. 60° W.	6.0	S. 63° W.	4.6	N. 85° E.	1.4	S. 84° E.	0.4	N. 81° W.	5.6	N. 75° W.	3.9	N. 84° E.	2.5	S. 13° W.	3.5	S. 86° W.	8.2	S. 67° W.	7.9
1,500	S. 40° W.	2.0	S. 43° W.	4.5	S. 65° W.	6.8	S. 71° W.	5.5	N. 75° E.	0.6	S. 48° W.	0.8	N. 77° W.	6.4	N. 79° W.	4.6	N. 56° E.	2.7	S. 25° W.	3.5	N. 85° W.	8.9	S. 72° W.	8.5
2,000	S. 52° W.	2.3	S. 50° W.	5.2	S. 68° W.	6.8	S. 79° W.	7.1	S. 54° W.	2.1	S. 68° W.	2.8	N. 77° W.	7.8	N. 79° W.	6.4	N. 34° E.	2.3	S. 45° W.	3.4	N. 84° W.	9.8	S. 75° W.	9.4
2,500	S. 69° W.	2.9	S. 61° W.	5.5	S. 80° W.	5.8	S. 81° W.	8.3	S. 66° W.	4.4	S. 81° W.	5.0	N. 77° W.	9.8	N. 77° W.	8.0	N. 36° E.	3.2	S. 57° W.	3.3	N. 79° W.	12.4	S. 80° W.	10.6
3,000	S. 85° W.	3.4	S. 69° W.	6.3	S. 76° W.	7.1	S. 85° W.	9.7	S. 65° W.	8.2	S. 80° W.	7.3	N. 68° W.	11.1	N. 78° W.	9.4	N. 42° E.	2.8	S. 63° W.	3.9	N. 76° W.	14.8	S. 83° W.	11.7
3,500	S. 64° W.	4.4	S. 70° W.	7.3	N. 85° W.	8.2	N. 86° W.	11.0	S. 76° W.	7.3	N. 89° W.	8.8	N. 75° W.	12.0	N. 85° W.	11.4	S. 73° E.	1.9	S. 50° W.	3.9	S. 89° W.	14.3	S. 83° W.	13.7
4,000	S. 43° W.	7.0	S. 65° W.	9.2	S. 89° W.	10.0	N. 88° W.	11.3	S. 71° W.	17.4	S. 70° W.	14.7	N. 83° W.	12.3	W.	11.8	S. 58° E.	5.7	S. 41° W.	2.8	N. 89° W.	15.4	S. 88° W.	13.0
4,500	S. 28° W.	8.9	S. 77° W.	10.2	S. 58° W.	8.6	N. 77° W.	11.3	N. 88° W.	17.0	S. 82° W.	14.2	N. 86° W.	14.2	S. 82° W.	13.4	N. 80° E.	9.1	S. 70° E.	4.0	S. 45° W.	21.0	S. 85° W.	16.3
5,000	S. 45° W.	8.8	S. 71° W.	11.5	S. 87° W.	5.6	N. 69° W.	8.5	N. 68° W.	16.8	N. 68° W.	16.7	N. 59° W.	17.3	N. 86° W.	14.4	.....	.....	.....	.....	S. 45° W.	26.2	S. 76° W.	20.2

THE WEATHER ELEMENTS.

By P. C. DAY, Meteorologist, in Charge of Division.

PRESSURE AND WINDS.

Compared with September the average pressure for October increases over all districts of both the United States and Canada, save from the Great Lakes eastward, where the increasing storm activity during October over the more stable conditions existing in September causes a general reduction in the average pressure in the district mentioned, as compared with the preceding month. In the far Northwest the permanent high-pressure area over the adjacent ocean during the warmer months of the year has usually advanced slightly inland by October, with the center of highest pressure over the interior portions of Oregon and Washington. Over the southeastern districts the permanent high pressure off the adjacent coast has likewise moved toward the land area and the center of highest pressure in October is usually over the southern Appalachian Mountain district.

During October, 1922, the areas of highest and lowest average pressure assumed nearly their normal locations, but the average pressure was on the whole below normal, this being particularly the case over the more easterly districts of both the United States and Canada. Over a narrow belt extending from the southern California coast to eastern Montana, western North Dakota, and the adjacent portions of the Canadian Northwest the average pressure was slightly above the normal.

Compared with the preceding month, the average pressure during October was decidedly lower, particularly from the Great Lakes eastward, where cyclonic disturbances were rather frequent during the last two decades. From the Great Plains westward the pressure during October, 1922, was higher than in the preceding month, but the excess was generally less than usually occurs.

Anticyclonic conditions existed over much of the country during the early part of the month; indeed, pressure was moderately high almost continuously over the districts from the Mississippi River westward until near the end of the month. As a result of this distribution of pressure, cyclones were confined mainly to the more eastern districts and even here they were mainly unimportant and occurred at infrequent intervals, save along the northern border from the Great Lakes eastward.

In the absence of important cyclones the air movement was moderate, and few damaging winds were reported.

Over the districts from the Mississippi River eastward the winds were mainly outward from the center of highest pressure, located over the southern Appalachian Mountains. In the Great Plains region they were largely from southerly points, except in the upper Missouri Valley, where they were from northwest to north. Over the districts to westward of the Rocky Mountains they were variable, as usual. A list of the comparatively few damaging windstorms of the month appears at the end of this section.

TEMPERATURE.

The outstanding feature of the weather during the month was the uniformly favorable temperature. Little uncomfortable cold occurred, and the changes from day to day were usually small.

The first decade of the month was nearly everywhere warmer than normal, the excess ranging up to as much as 12° per day in the middle Plains region. During this period the highest temperatures of the month were recorded in practically all portions of the country, and over the interior portions the highest ever observed in October were reported from numerous places.

At the beginning of the second decade an anticyclone of considerable magnitude was advancing into the upper Missouri Valley and the coldest weather of the season to date was reported from the adjacent Canadian Provinces. This anticyclone advanced rapidly southeastward during the following few days, attended by freezing temperatures as far south as Kansas and Iowa, and frosts were reported from portions of the Ohio Valley and Appalachian Mountain regions.

The week ending the 17th was on the whole colder than normal by several degrees over a wide area embracing most of the central valleys and southeastern districts. It continued slightly warmer than normal from the west Gulf coast northwestward to Oregon and Washington, and generally over the Northeastern States. The lowest temperatures of the month occurred during this week over large areas from the middle Plains northward to Canada.

For the week ending the 24th, temperatures continued generally below normal over the Great Lakes and in the Ohio and Mississippi Valleys, and cool weather extended over New England and into Texas and New Mexico. Over the Northwest and generally from the Rocky Mountains westward the averages for the week were above normal; the lowest temperatures of the month occurred during this period over most districts from the Mississippi River eastward and in portions of the southern Plains.